Radiation Belt Storm Probes Research and Operations

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with many contributions from
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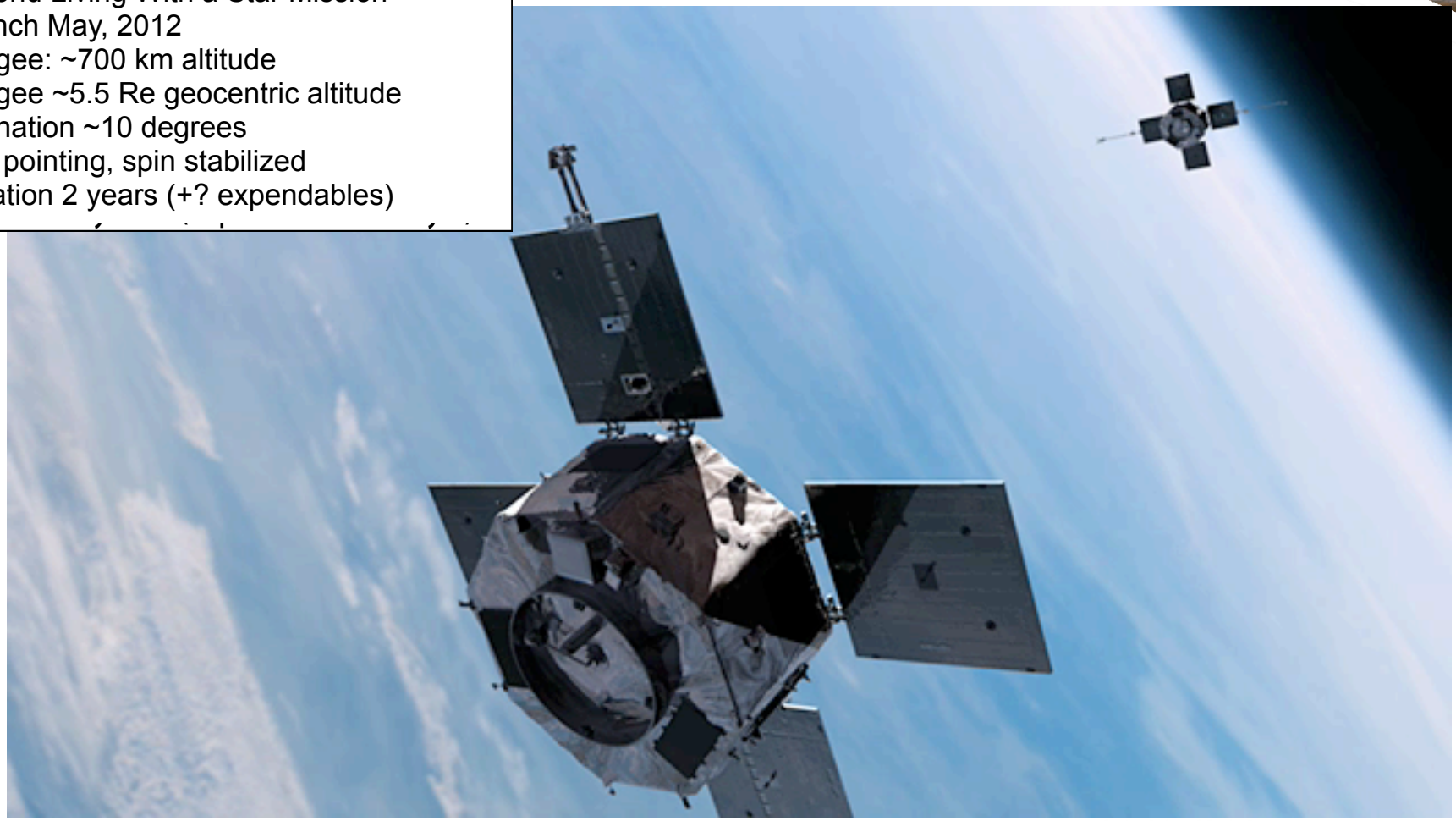
RBSP Mission Overview

RBSP Mission Facts:

Second Living With a Star Mission
Launch May, 2012
Perigee: ~700 km altitude
Apogee ~5.5 Re geocentric altitude
Inclination ~10 degrees
Sun pointing, spin stabilized
Duration 2 years (+? expendables)



RBSP is a *Research* Mission

Understand, ideally to the point of predictability, how populations of relativistic ions and electrons in space are formed or changed in response to the variable inputs of energy from the sun

We will fulfill this objective by:

Understanding the acceleration, global distribution, and variability of energetic electrons and ions in the inner magnetosphere

Is RBSP an *Operations* Mission?

NO... but...

RBSP can be used in operations and provides a demonstration/validation for operational missions

- ACE is the SW model for RBSP
- RBSP will have a Space Weather Broadcast
- International agreements will help collect data which will be available in real time to any users

Space Weather Data Products

- Space Weather data products are a subset of full science data
- Processing algorithms will be provided by science teams
- Full science data will include gap-filling SW data

					#bits/ component	Data Product Report Rate (bps):
Magnetic Field						
1 vector sample per 5 spins x 3 components					16	0.80
Electric Field						
1 vector sample per 5 spins x 3 components					16	0.80
ULF Wave Power						
1 vector magnetic field sample per 6 secs x 3 components					16	8.00
Plasma Density						
1 spacecraft potential value (±250 V) per 5 spins					12	0.20
Particle Count Rates (electrons & protons)						
energy bin centered at or near:	~bin width:	per # spins	# angles per quarter spin	#az angles		
25 eV	50 eV	5	1	1	12	0.40
300 eV	100 eV	5	5	1	12	2.00
1 keV	5 keV	5	1	1	12	0.40
30keV	10 keV	5	5	1	12	2.00
70 keV	30 keV	5	5	1	12	2.00
150 keV	50 keV	5	1	1	12	0.40
300 keV	100 keV	5	5	2	12	4.00
600 keV	200 keV	5	1	2	12	0.80
1 MeV	1 MeV	5	5	2	12	4.00
3 MeV	2 MeV	5	1	1	12	0.40
>10 MeV*	n/a	5	5	1	12	1.00
>50 MeV*	n/a	5	1	1	12	0.20
>400 MeV*	n/a	5	5	1	12	1.00

NOTES:

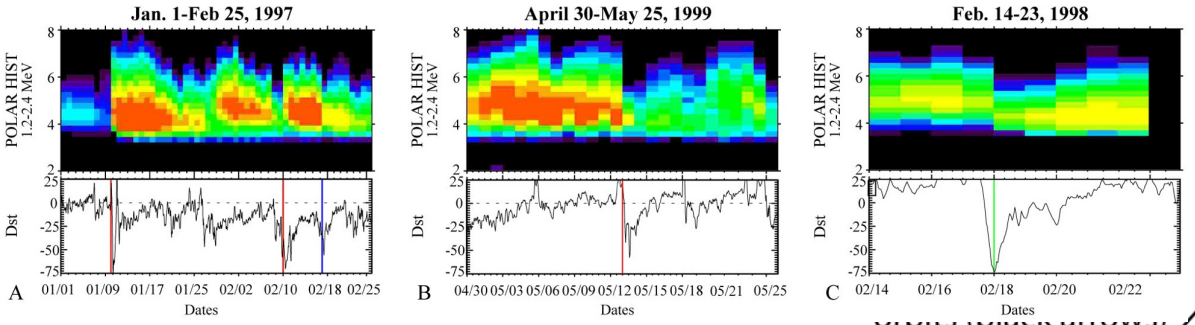
Spin rate (s)= 12

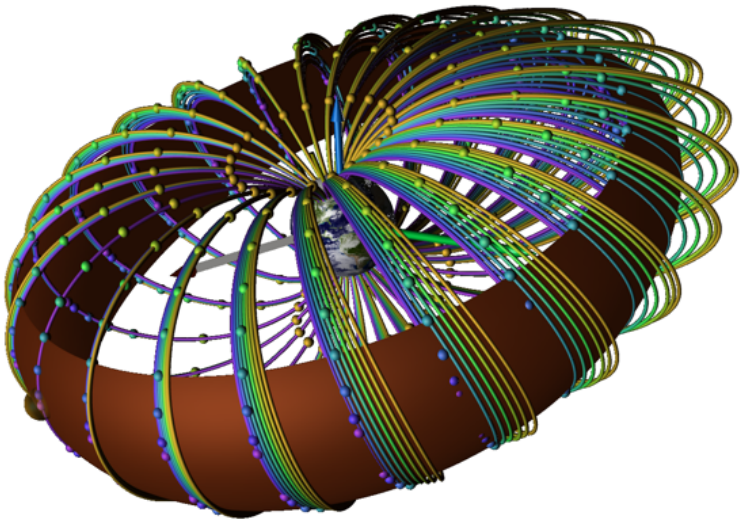
*no electrons reported above 10MeV

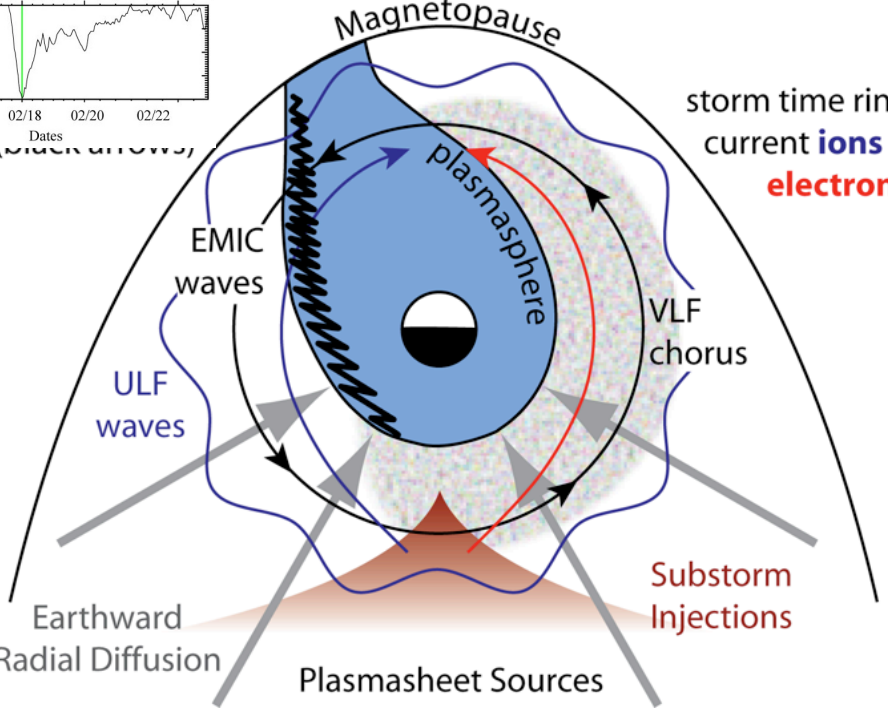
TOTAL DATA PRODUCT REPORT RATE: **28.40**

RBSP Measurements

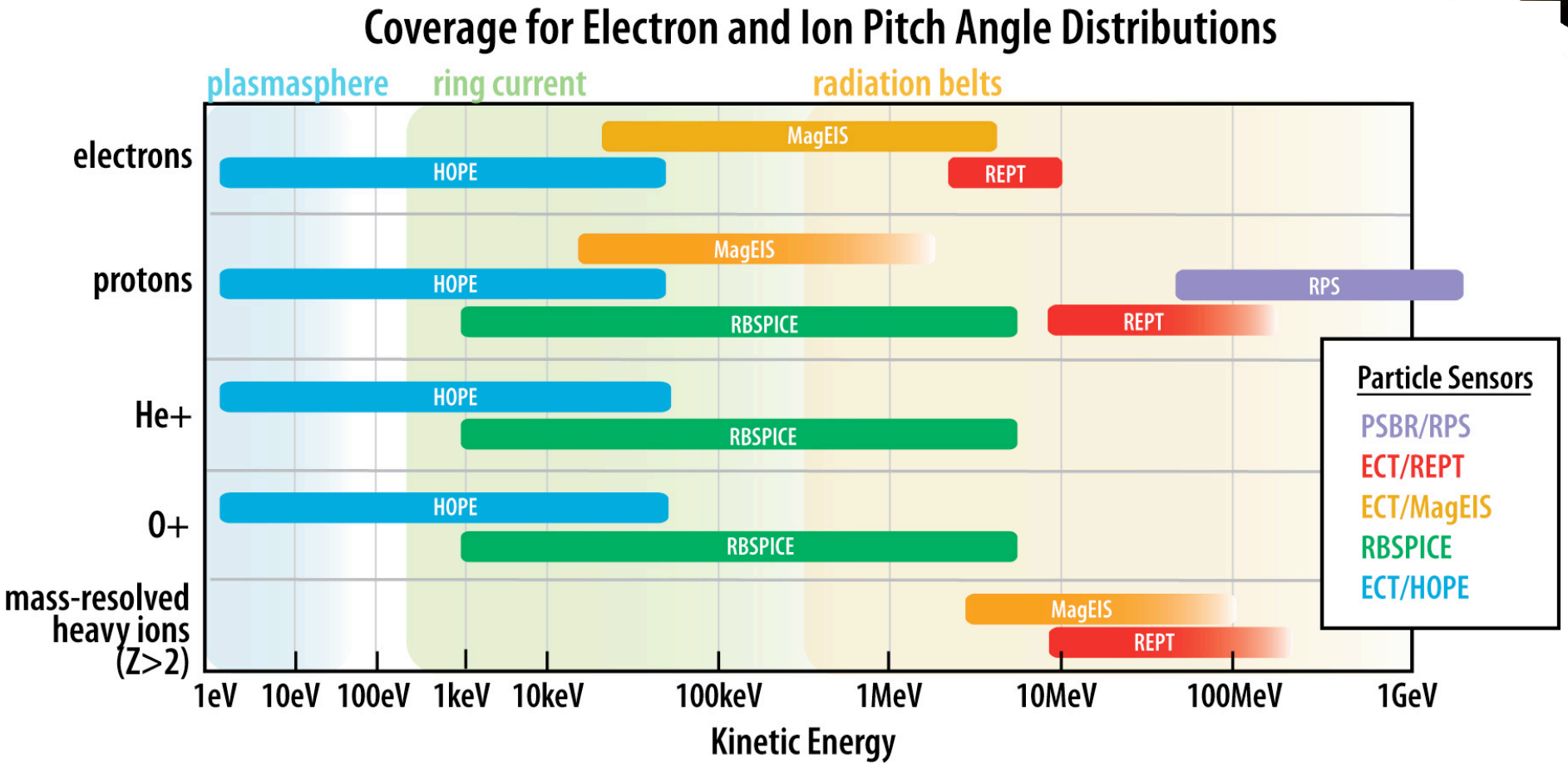
- The radiation belts are part of a highly-coupled system
- It is most dynamic during geomagnetic storms (which are messy)
- RBSP measurements satisfy the minimum required observations for targeted radiation belt science



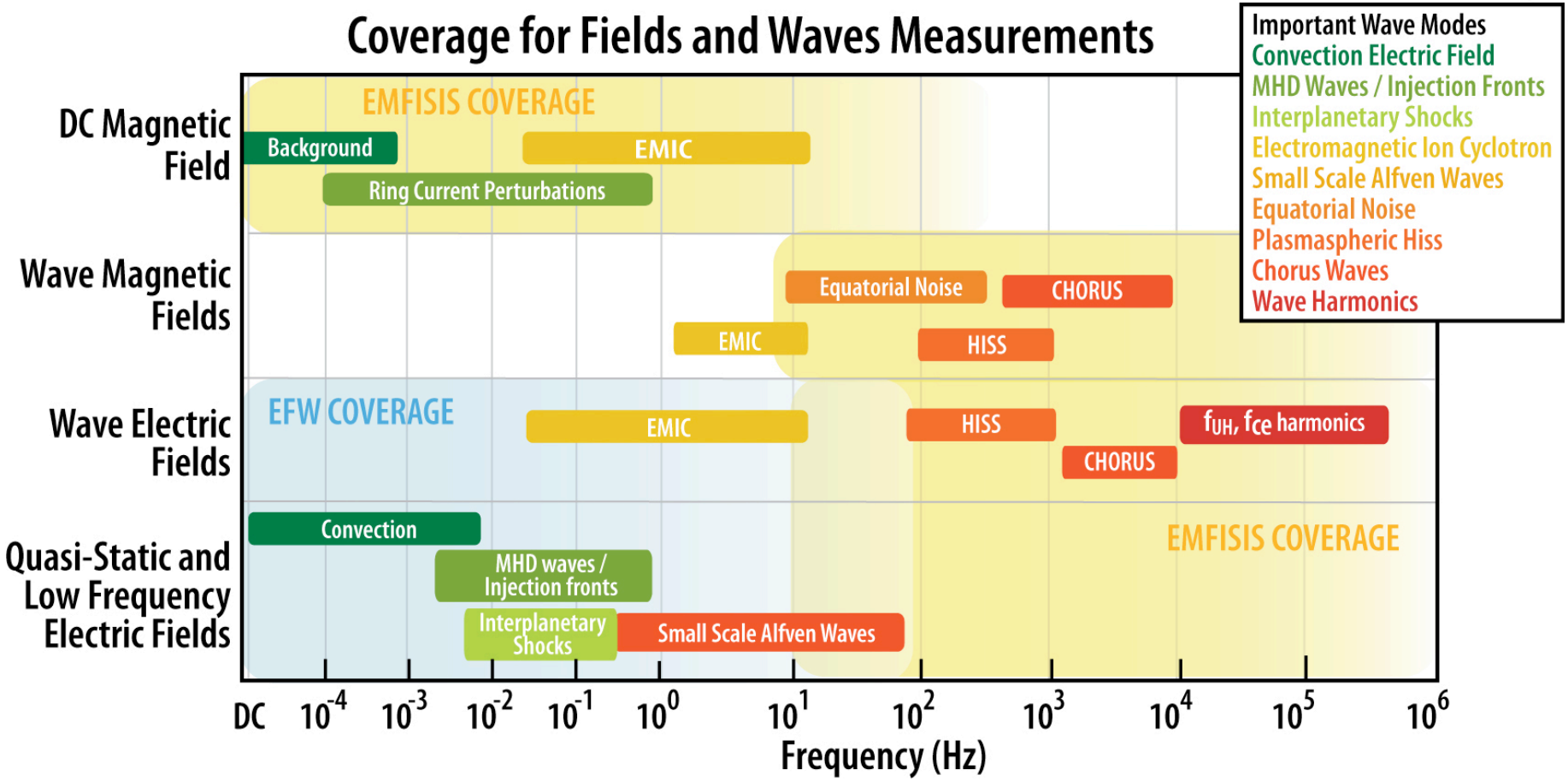




Particle Experiments



Field & Wave Experiments



Using the RBSP SW Beacon

- Implementation of SW beacon will be "ACE/STEREO-mode" … the RBSP mission will provide transmit only.

  (mission science data is stored and downlinked once per day)

- Small subset of RBSP science dataset will be continuously transmitted (~200 bps) via the beacon.
- International agreements with S. Korea (done) and Czech Republic (nearly complete) but anyone can collect the SW broadcast.
- Data will be aggregated, sorted, and minimally processed at APL which will serve as the portal for RBSP data.
- Remember there are 2 satellites!

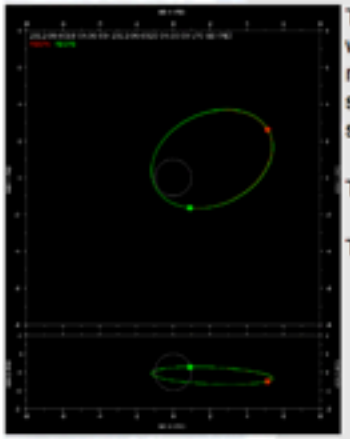
Radiation Belt Storm Probes Mission

Exploring the Extremes of Space Weather

Science Data Portal - Home

Welcome to the RBSP Science Data Portal.

The RBSP Science Data Portal provides a common point of entry of specific interest to the RBSP community. The portal provides ancillary services, tools, data and links that benefit the RBSP project. Consistent with NASA policy, all RBSP observations and software will be fully accessible to the research community.



The two RBSP spacecraft will be placed in unusual and highly elliptical orbits which will provide data from the non-traditional orbit locations - operational mointoring satellites are usually at or near geosynchonous orbit. For 3-D specification models, these altitude-varying profiles will provide greater sampling of Earth's radiation environment.

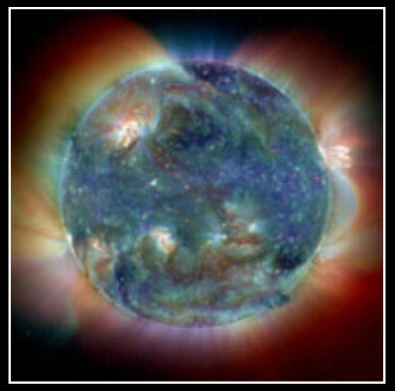
To see the RBSP spacecraft orbits, click here

To access the RBSP position calculator, click here

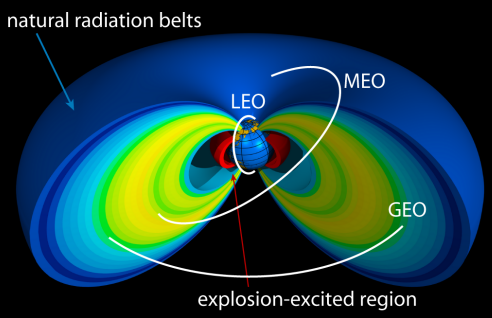
One Application

DREAM

The Dynamic Radiation Environment Assimilation Model



Natural Sources

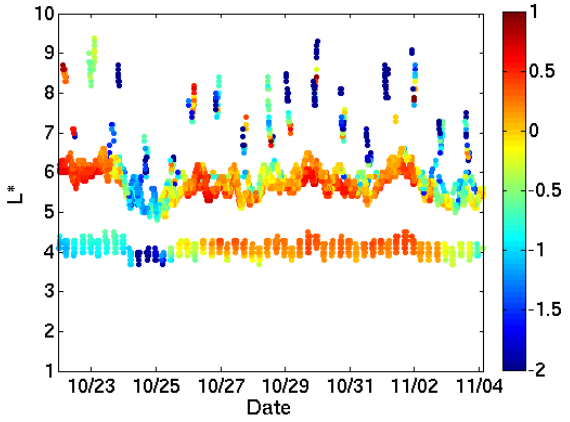


Nuclear Sources

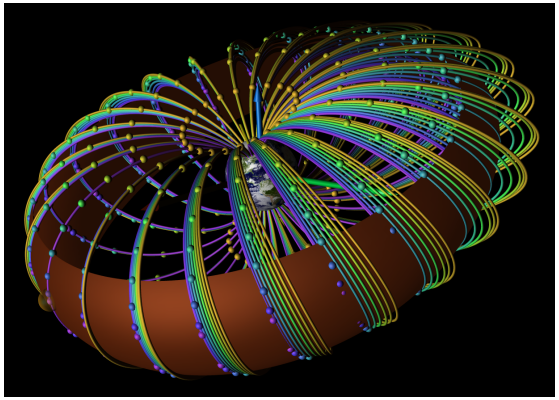
Los Alamos NATIONAL LABORATORY EST. 1943

Radiation Belt Data Assimilation

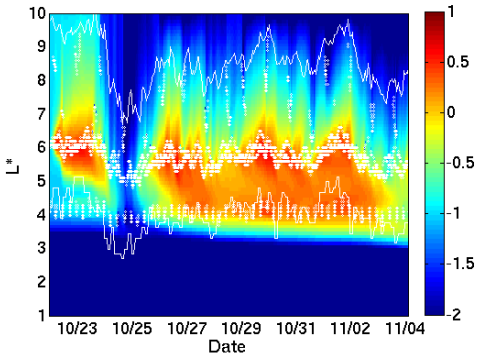
Sparse and/or Heterogeneous Observations



Complex Physical System

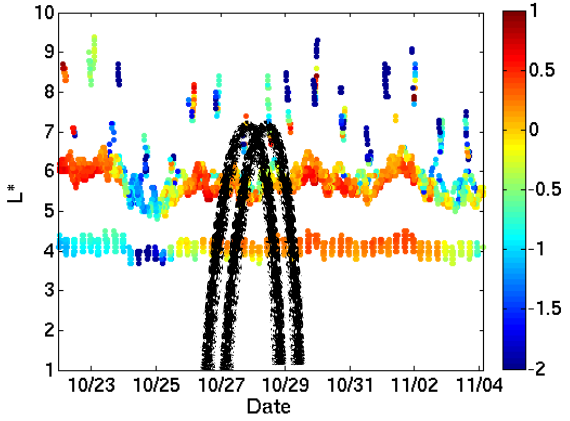


Output: Global specification or forecast of the state of the Radiation Belts



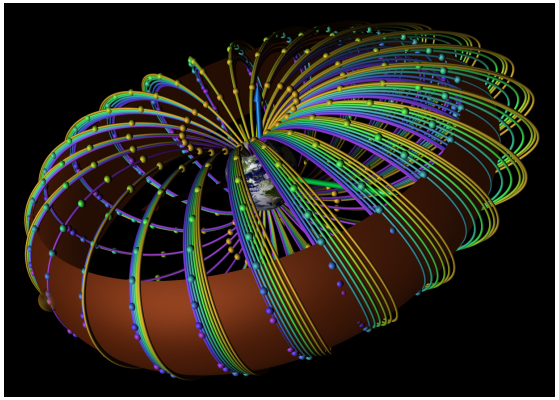
Radiation Belt Data Assimilation

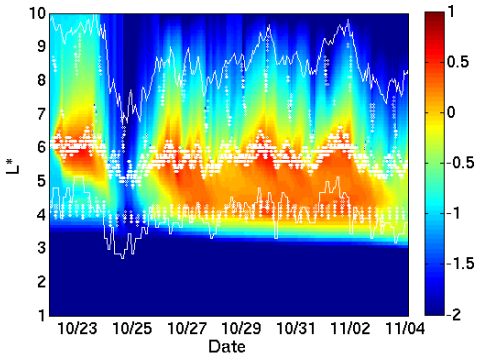
Sparse and/or Heterogeneous Observations



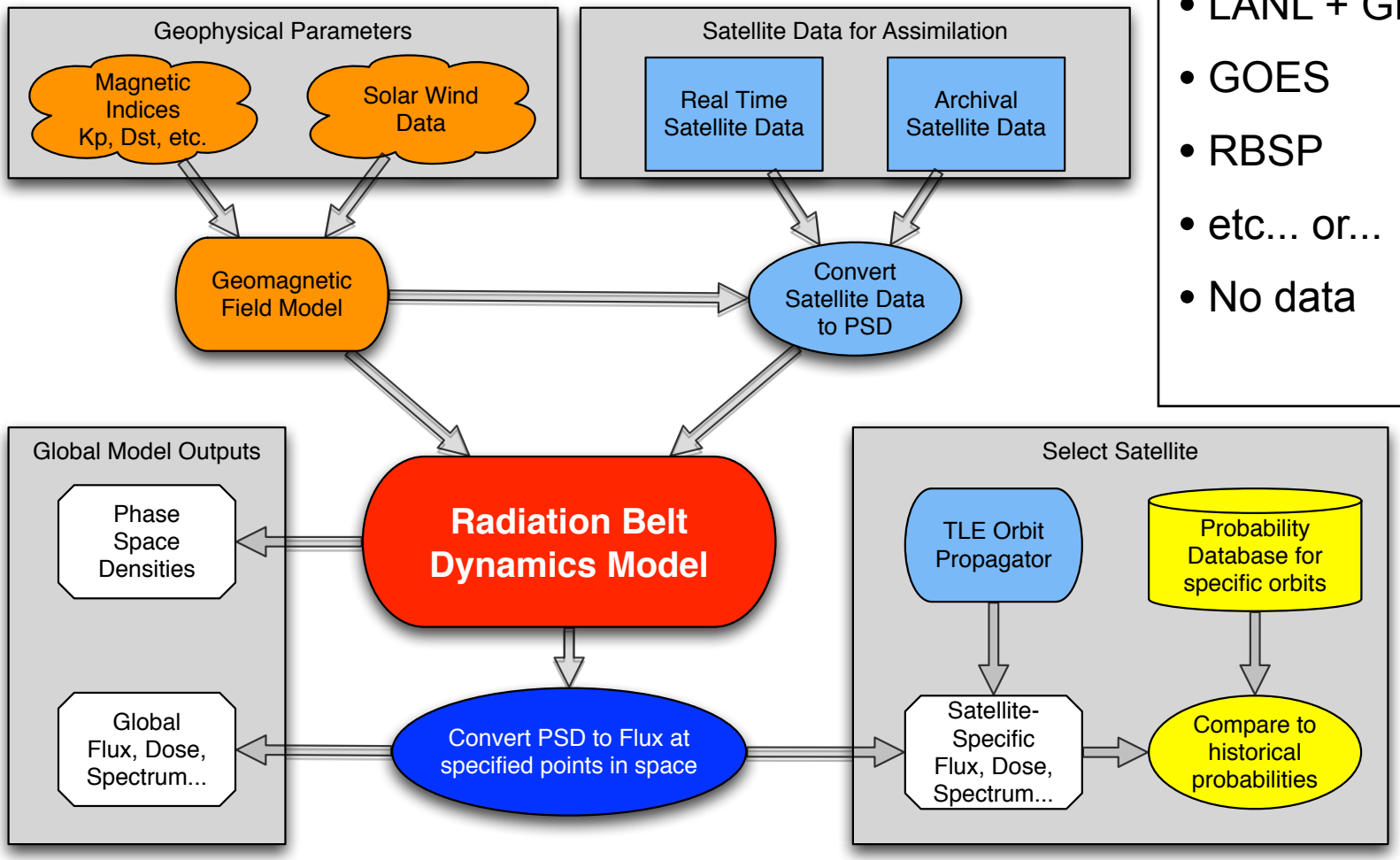
RBSP data will be much less sparse

Complex Physical System





DREAM Flow Chart

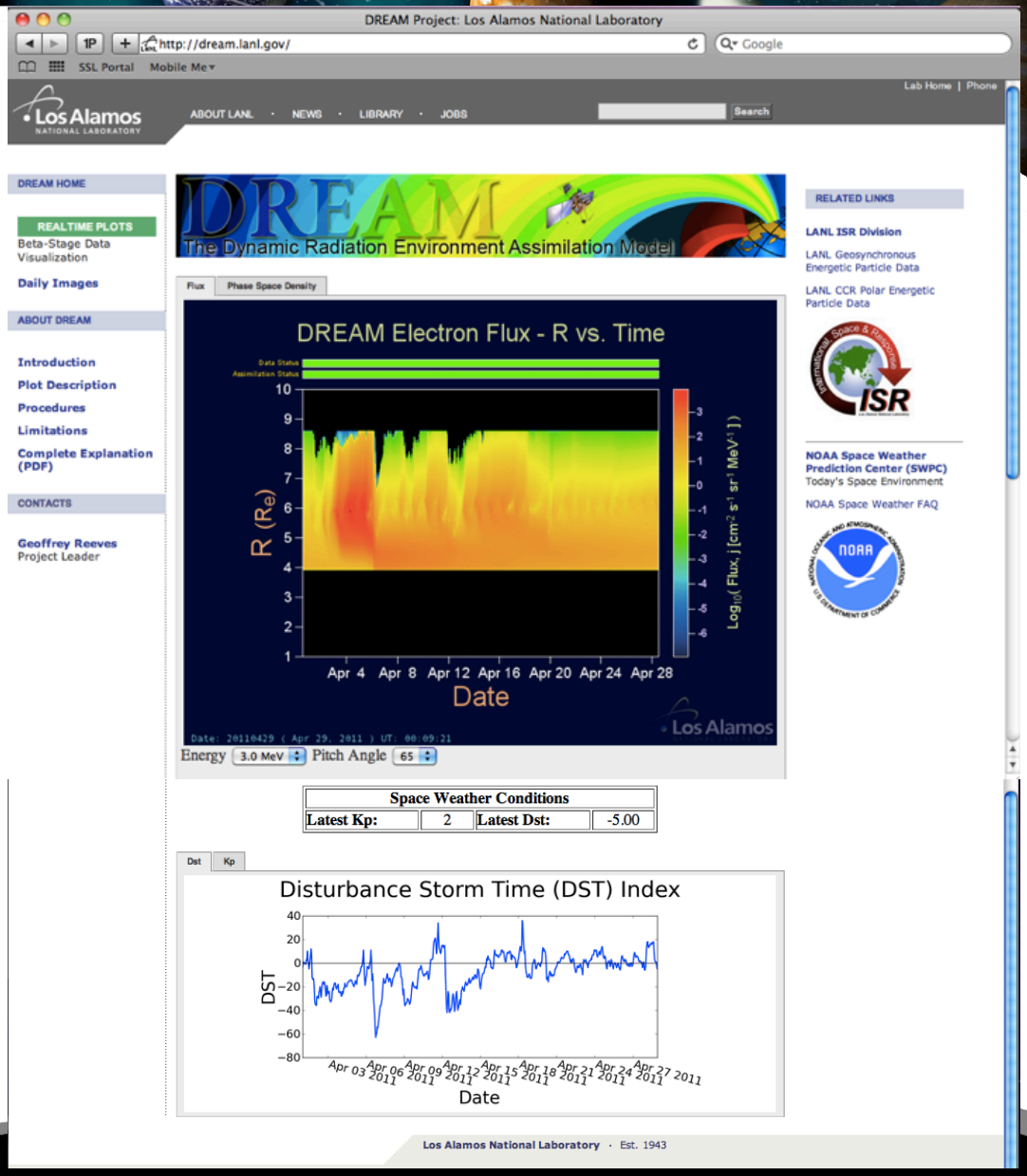


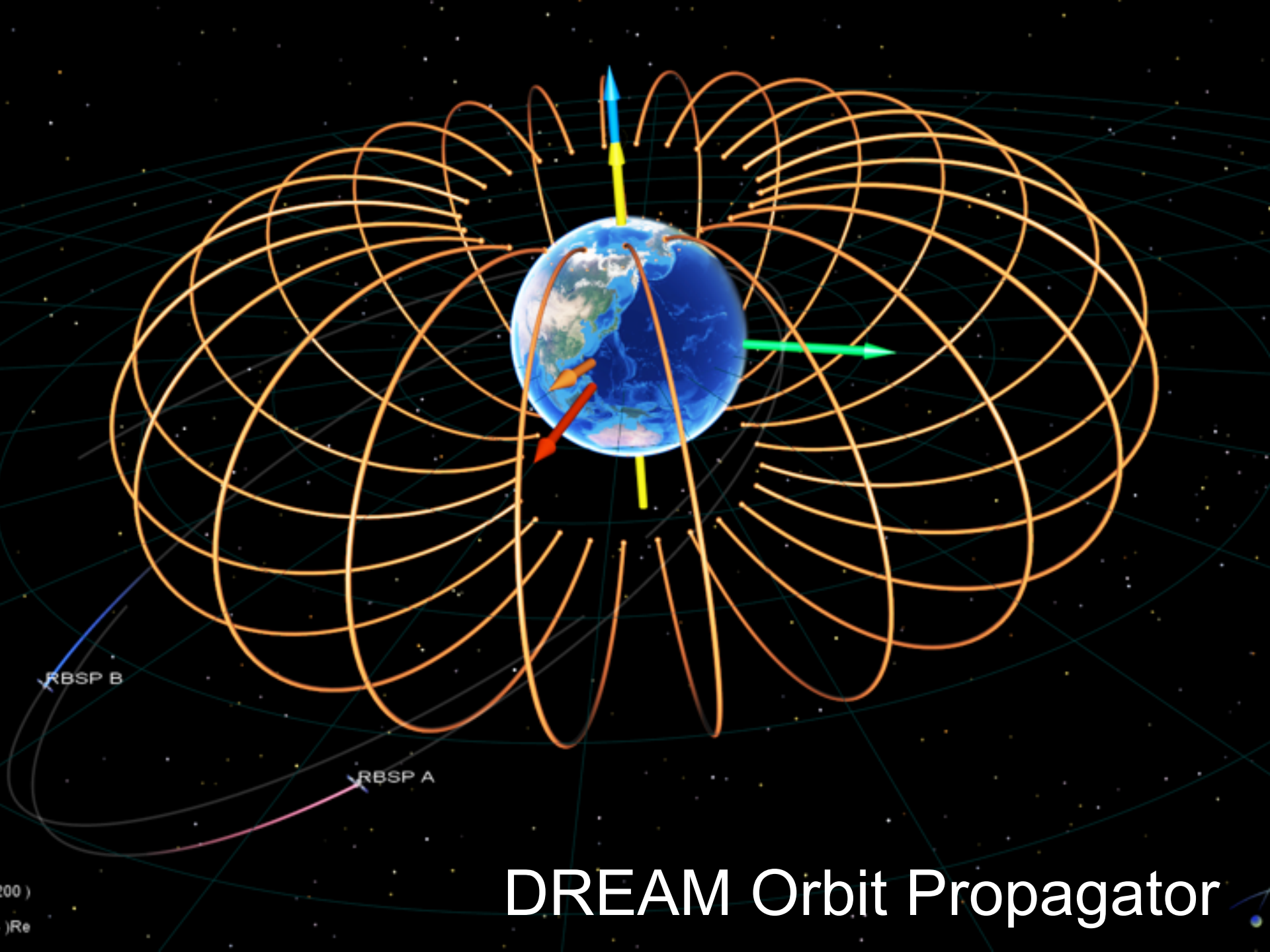
Satellite Data =

- LANL + GPS
- GOES
- RBSP
- etc... or...
- No data

Real-Time Beta

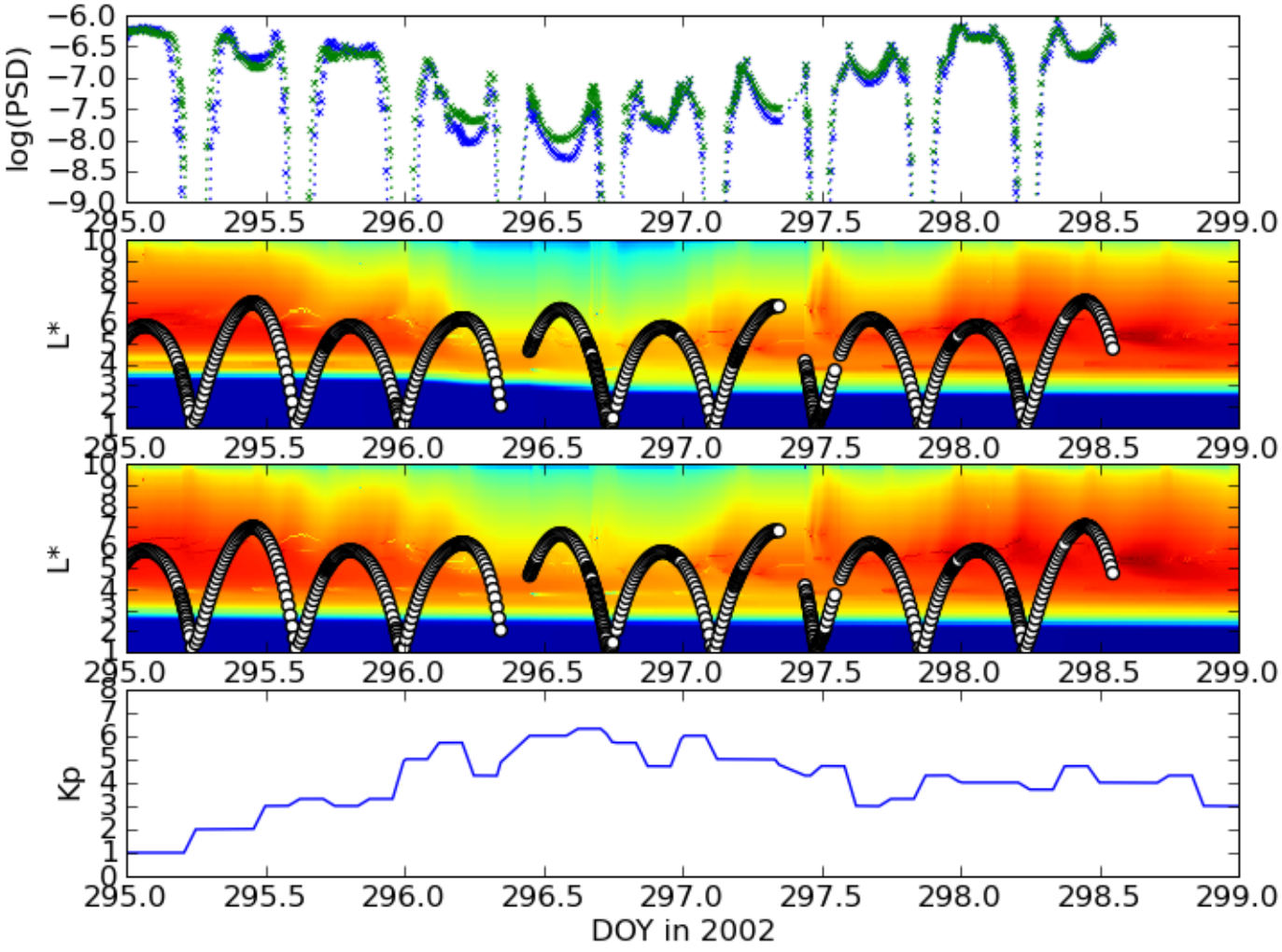
- http://dream.lanl.gov
- uses GOES 13 only
- data limitations = model output limitations
- RBSP SW data can drive exactly the same web service but with incredibly complete coverage in energy pitch angle and L





DREAM Orbit Propagator

Virtual Spacecraft Studies



- Kp dependent
- static

Kp dependent

static diffusion

RBSP and Space Weather

- RBSP is a mission designed to understand the physics of the radiation belts
- The measurements are the ones that are required to test competing theories and advance state-of-the-art
- Those same measurements have outstanding potential for Space Weather Applications
- Real-time data collection, distribution, and assimilation provide an unprecedented opportunity to demonstrate/validate operations concurrently with research
- It is coming soon!

How Close?